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Evaluation of mungbean (*Vigna radiata* (L.) Wilczek) genotypes based on yield stability

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Abstract
Sixteen genotypes of mungbean were sown on three different sowing dates in randomised block design, with three replications at Pulses Research Unit, PDKV Akola for the estimation of genotypes stability by employing the Eberhart and Russell model. The data on seed yield was subjected to genotype × environment interaction analysis to identify stable and high yielding genotypes. Significant G × E interaction revealed differential performance of the genotype over the environments. Based on stability analysis, the genotype *viz.*, AKM-12-22 and AKM-12-24 were found to be stable and high yielding across the environments. Hence, these genotypes can be recommended for all the three environments. The genotypes *viz.*, PKV–AKM-4and BM–2003-2 were observed below average stable for most of the yield contributing characters and can be recommended for rich or favourable environment. AKM-12-28 showed above average stability for most of the yield contributing characters and can be used for poor or unfavourable environment.

Keywords: Mungbean, stability, genotype × environment interaction, environments, Eberhart and Russell model

Introduction

Mungbean (*Vigna radiata* L. Wilczek), is an important short duration pulse crop extensively grown in India under varying soil types and climatic conditions. The climate change can cause unpredictable drought and heat stress. So it is necessary to have s table genotypes. The genotype × environment interaction studies are as important as crop improvement. In any breeding programme, it is necessary to screen and identify phenotypically stable genotypes which could perform more or less uniform in different environments. Thus, breeding for climate or environment resilient varieties is crucial (Allard and Bradshaw, 1964) [2]. Significant achievement in crop production may bepossible by breeding varieties for their stability for yield and yield components (Singh *et al.*, 2009). The phenotype of an individual is determined by G × E interaction. The phenotypic response to change in environment is not same for all the genotypes. Mungbean being a short duration crop, succumbs very much to the changing environments. Hence, it is necessary to study the performance of mungbean genotypes sown on different dates along with their stability.

Materials and Methods

In the present study sixteen genotypes of mungbean were evaluated on three different sowing dates of 2016 (7 June, 22 June and 7 July) in randomized block design with three replicationsatpulses research unit PDKV Akola, Maharashtra, India. Each genotype was sown in four rows of 3 m length with a spacing of 45 x 10 cm. All the recommended agronomic and cultural package of practices were adopted for each sowing dateto raise a healthy crop. The collected subjected to stability analysis as proposed by Eberhart and Russell (1966) [6].

Results and Discussion

G × E interactions have major importance to plant breeders in developing improved varieties for different environments. Low levels of interactions are useful for some characters to maximize stable performance over a number of environments. The interactions of genetic and non-genetic factors on phenotypic expression is called G × E interaction which is widely present and substantially contributes to the non-realization of expected gain from selection (Comstock and Moll, 1963) [5]. Stable genotypes are particularly of great importance in India, where green gram is grown as a risk under varied environmental conditions. G × E interaction certainly plays an important role in the evaluation and execution of breeding programmes.

Allard and Bradshaw (1964) [2] have critically reviewed this phenomenon and brought out its implications in applied plant breeding. Thus, G × E interaction is important in the expression of quantitative characters, which are controlled by polygenic systems and largely influenced by environmental fluctuations.

In the present investigation, sixteen genotypes of mungbean were subjected to pooled analysis of variance over three different environments (Table 1). Development of stable breeding lines or varieties is one of the primary objectives of all breeding programmes. Pooled analysis of variance (Table 1) showed significant differences among the genotypes and environments for seed yield, indicating substantial variability among the genotypes and environments for seed yield. The significant values of G x E interactions for seed yield revealed the interaction of the genotypes with environments. The earlier workers such as, Joshi (1969, 1972) [9, 8], Choudhary and Haque (1977) [4], Miah and Corangal (1986) [10], Pathak and Lal (1987) [14], Pathak *et al.* (1990) [15], Reddy *et al.* (1990) [17], Naidu and Satyanarayana (1991a) [11], Naidu and Satyanarayana (1991 b) [12], Gomashe (2003) [7], Rao *et al.* (2004) [16], Swamy and Reddy. (2004) [18], Abbas *et al.* (2008) [1], Nath (2012) [13], and also Arunkumar and Konda (2014) also observed significant differences among the genotypes, environments and G × E interaction.

Partitioning of G × E interaction exhibited that G × E (linear) effect was significant for all the characters when tested against pooled error, indicating the predictability of the performance of genotypes over environments. Both linear and non-linear components of G × E interactions were significant indicating that genotypes responded linearly to environmental changes for all these characters. Environment (linear) effect was significant for seed yield per plant when tested against pooled deviation and pooled error. Nath (2012) [13] also reported significant environment (linear) effect for majority of traits in mungbean. According to Eberhartand Russell (1966) [6], a stable genotype should be with high yield, non-significant squared deviation from regression and average response to the environment.

Among the 16 genotypes *viz*., AKM-10-11 (5.71g), AKM-12-12 (5.50g), AKM-12-22 (5.38g) and AKM-12-24(5.37g) produced highest seed yield per plant as compared to other genotypes (Table 2). It also exhibited regression coefficient nearer to unity and non significant deviation from the regression line and hence, considered as stable genotypes. The genotypes *viz.*, AKM-10-10, AKM-12-15, PKV AKM-4 and BM 2003-2 had regression coefficient significantly greater than unity, high mean and non-significant S^2di values and considered as below average responsive genotypes and suitable for favourable environments while two genotypes *viz.*, AKM-12-23 and AKM-12-28 had regression coefficient significantly less than 1 with superior mean and non-significant S^2di and can be considered as above average responsive genotypes and suitable for poor or stress environments.

From the present study it can be concluded that genotype *viz.*, AKM –12 –22 and AKM 12 – 24 were stable in three different sowing dates for yield contributing character and these genotypes can be recommended for all the three types of environments. The genotype AKM–12–28 found above average stability for yield contributing characters and can be used for poor or unfavourable environment. These genotypes recommended for farmer for stress environment.

Table 1: Pooled ANOVA for stability analysis as per Eberhart and Russell (1966) [6] for seed yield per plant in mungbean

Source of variation	Df	Mean sum of square
Genotype	15	2.158**
Environment	2	0.395**
G × E	30	0.026
E + G × E	32	0.049**
Environment (linear)	1	0.790**
G× E (linear)	15	0.37*
Pooled deviation	16	0.014*
Pooled error	90	0.028*

Note: * and ** indicate significant at 0.05 and 0.01 levels of Probability

Table 2: Estimates of stability parameters for seed yield per plant in mungbean

Sr. No.	Genotypes	Mean seed yield/ plant	Bi	S^2di
1	AKM-10-5	5.06	0.25	-0.02
2	AKM-10-10	5.29	1.53	-0.03
3	AKM-10-11	5.71	1.16	-0.02
4	AKM-10-21	4.37	0.44	-0.03
5	AKM-12-04	3.79	0.36	-0.03
6	AKM-12-06	3.39	2.22	0.08
7	AKM-12-10	4.18	-0.81	0.02
8	AKM-12-12	5.50	0.87	-0.03
9	AKM-12-14	4.31	0.71	-0.03
10	AKM-12-15	5.49	2.77	-0.02
11	AKM-12-22	5.38	1.16	-0.03
12	AKM -12-23	5.62	0.49	-0.03
13	AKM -12-24	5.37	0.82	0.01
14	AKM-12-28	5.35	0.59	-0.02
15	PKV AKM-4 (Ch)	6.18	1.90	-0.02
16	BM 2003-2(Ch)	6.43	1.54	-0.02

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